

WHAT IS CLAIMED IS:

- 1 1. A method of making a lithiated manganese dioxide for a primary lithium
2 battery comprising:
3 contacting a manganese dioxide with a lithium ion source at a lithiation
4 temperature sufficient to substantially replace protons in the manganese dioxide with lithium
5 ions; and
6 heating the manganese dioxide at a water removal temperature sufficient to
7 substantially remove residual and surface water to produce a lithiated manganese dioxide
8 having an X-ray diffraction pattern substantially similar to the X-ray diffraction pattern of the
9 manganese dioxide prior to lithiation.
- 1 2. The method of claim 1, wherein the manganese dioxide is persulfate derived
2 chemical manganese dioxide.
- 1 3. The method of claim 1, wherein the manganese dioxide is gamma-manganese
2 dioxide.
- 1 4. The method of claim 1, wherein the lithium ion source is an aqueous solution
2 including a lithium salt.
- 1 5. The method of claim 4, wherein the lithium salt is a lithium hydroxide.
- 1 6. The method of claim 1, wherein the lithiation temperature is between 40 C
2 and 100 C.
- 1 7. The method of claim 1, wherein the water removal temperature is between
2 180 C and 500 C.
- 1 8. The method of claim 1, wherein the water removal temperature is between
2 200 C and 460 C.
- 1 9. A method of making a cathode for a battery comprising:
2 contacting a manganese dioxide with a lithium ion source;
3 heating the manganese dioxide to produce a lithiated manganese dioxide

4 having an X-ray diffraction pattern substantially similar to the X-ray diffraction pattern of the
5 manganese dioxide prior to lithiation; and

6 coating a current collector with a composition including a carbon source, and
7 the cathode active material, wherein the cathode active material includes a manganese
8 dioxide.

1 10. The method of claim 9, wherein the manganese dioxide is persulfate derived
2 chemical manganese dioxide.

1 11. The method of claim 9, wherein the manganese dioxide is gamma-manganese
2 dioxide.

1 12. The method of claim 9, wherein the lithium ion source is an aqueous solution
2 including a lithium salt.

1 13. The method of claim 12, wherein the lithium salt is a lithium hydroxide.

1 14. The method of claim 9, wherein the lithiation temperature is between 40 C
2 and 100 C.

1 15. The method of claim 9, wherein the water removal temperature is between
2 180 C and 500 C.

1 16. The method of claim 9, wherein the water removal temperature is between
2 200 C and 460 C.

1 17. A primary lithium battery comprising:
2 an anode including a lithium-containing anode active material;
3 a cathode including a lithiated manganese dioxide having an X-ray diffraction
4 pattern substantially similar to the X-ray diffraction pattern of the manganese dioxide prior to
5 lithiation; and
6 a separator between the anode and the cathode.

1 18. The battery of claim 17, wherein the lithium-containing anode active material
2 is lithium or a lithium alloy.

1 19. The battery of claim 17, further comprising a nonaqueous electrolyte in
2 contact with the anode, the cathode and the separator.

1 20. The battery of claim 19, wherein the nonaqueous electrolyte includes an
2 organic solvent.

1 21. The battery of claim 17, wherein the battery has high current capability and
2 discharge capacity greater than a lithium-manganese dioxide battery including heat treated
3 manganese dioxide.